
Dr. George Wagner  848-445-4660          gcwagner@rci.rutgers.edu

class time: Tues 8:00 AM-4:00 PM   Room 101

This text provides a comprehensive foundation for the topics discussed in class. Additional readings are assigned for each lecture and intended to provide students with current research and controversy on each topic; each article will be thoroughly critiqued, at first by the instructor and then with expectation that students participate increasing in critique as the course progresses, particularly with respect to methodology and validity of the author’s interpretations of the data.

Overall Learning Objectives:  With the successful completion of this course, students will have a strong background in the science of the biological bases of human behavior.  They will be able to account for human behavior on the basis of genetic and epi-genetic regulation of protein expression, the numerous events that affect development of the nervous system, and the neurochemical function of the adult brain, its many divisions, and its interaction with the endocrine and immune systems.  This is a rapidly developing field, particularly with respect to gene manipulation and neuroimaging.  Therefore, the most important objective is to train students such that they are well prepared to interpret and critically assess future research.  To achieve this objective, the instructor will challenge students to develop alternative interpretations of data, particularly with respect to areas of controversy.

date
5/28
Introduction: Neurons and Glial
Neuron Physiology; Nernst equation; resting membrane potential; action potential; transmitter release; post-synaptic potentials; Glial cells: phagocytosis; neuromodulation; insulation; brain trauma Assessment of Unconditioned and Conditioned Behavior

Learning Objectives:  Introduce the students to the nervous system and its major cell types. Then explain and use the Nernst equation to construct a working model of the resting membrane potential bringing into play the forces of osmosis, electrostatic pressure and the sodium/potassium pump. Then explaining and using voltage clamp technology, show how actions potential can be generated and move from node to node along the axon. Finally, for the first half of the lecture, bring the action potential to the terminal and explain exocytosis, chemical transmission, and post-synaptic potentials.

For the next section, move to the function of glial cells and their involvement in normal chemical transmission as well as their response following brain trauma. Explain and critique the site of action of “SSRI’s” as a glial-mediate response rather than on the serotonin neuron.

The last part of the first lecture shows how behavior is assessed using unconditioned and conditioned behavior paradigms.

Readings:  Chapter 1: Introduction (Biological Roots of Behavioral Neuroscience; Evolution of Human Species; Evolution of Large Brains).
Chapter 2: Structure and Function of Nerve Cells (Cells of the Nervous System; Communication Within and Between Neurons)

6/4
Neuroanatomy: myelencephalon; metencephalon; mesencephalon; diencephalon; telencephalon Evolution of the Nervous System; Evolution of Behavior Development of the Nervous System; Development of Behavior Neuroscience Techniques: PET and CAT Scans and MRI Regulation of Gene Expression

Learning Objectives: The major divisions of the central nervous system are carefully reviewed twice, first from an evolutionary perspective and then from a developmental perspective. The students are
challenged to draw parallels between evolution of and development of the nervous system but are also challenged to show gaps and differences between the two. Most important, the development of the frontal cortex of humans is emphasized. The students are exposed to the importance of gene conservation through species from plants and invertebrates all the way to humans, thus revealing the evolutionary heritage of human behavior. As an example, the study of ion transporters in spinach sheds light on learning and memory in mammals. The genetics of axon guidance molecule expression are introduced in discussion of autism and the controversy surrounding the idea that vaccination might lead to autistic regression is explored. Finally, neuroimaging techniques are discussed and compared with respect to the actual data. The limitations and over-interpretation of the imaging data are reviewed: e.g. does CBT really change the brain in a way that could possibly be mimicked by antidepressants?


Chapter 3: Structure of the Nervous System: (Features of the Nervous System; Central Nervous System) Chapter 5: Methods and Strategies of Research (Studying Structure of the Human Brain; Neurochemistry; Genetic Methods)

6/11 Chemical Transmission and Pharmacology: Pharmacokinetics: route of admin; absorption & distribution; time course; dose-response; metabolism & clearance; drug interactions; tolerance & sensitization; dependence & withdrawal; generic vs. brand-name differences Pharmacodynamics: mechanism of action (agonist vs. antagonist); drug effects Neuropathology

Learning Objectives: The first lecture introduced the resting membrane potential, a membrane separating two pools of chemicals. It should be no surprise then that chemicals introduced into the body can manipulate the membrane potential and change behavior in very predictable ways. The broad field of pharmacology is reviewed with numerous examples of how chemicals (traditional drugs, vitamins, and even "organic" plant borne herbicides and insecticides) affect human behavior.

The second part of the behavior is how neuropathology can provide insight into normal function of brain regions. From historic cases such as Phinias Gage and HM to today's understanding of the neuropathology of schizophrenia, the study of what happens when things go wrong in the brain says much about the biological bases of normal human behavior.


Chapter 4: Psychopharmacology Chapter 16: Schizophrenia and Affective Disorders Chapter 17: Anxiety Disorders

6/18 Exam 1 Movement: Pyramidal Motor System: cortex to spinal cord Extrapyramidal Motor system; Parkinson's disease Incentive Motivation

Learning Objectives: How and why do we move? The "hows" are not too difficult to understand once the pyramidal and extrapyramidal motors systems are reviewed. As above, when things go wrong (i.e. Parkinson's disease) is used to explain the normal function of the central motor systems. The "why" we
move question is more of a challenge and is introduced here in the concept of incentive motivation and then covered again next week.

Chapter 8: Control of Movement (Control of Movement by Brain)
Chapter 15: Neurological Disorders: (Degenerative Disorders)
Chapter 18: Drug Abuse

6/25 Ingestive Behavior: Regulation of food intake and body weight: alimentary system and regulatory hormones
Sleep Behavior: Circadian rhythms; the sleep stages; development and sleep disorders of sleep

Learning Objectives: Why do we eat and why do we sleep? The requirements for fuel are first reviewed and then the physiology of the alimentary system is introduced. Next, the storage and utilization of ingested fuels are covered during both the absorptive and fasting phases. Regulatory hormones are introduced and then the complex interaction of circulating hormones and body fat deposition are reviewed in the context of body weight set points leading to obesity. The lecture concludes with an overview of sleep, the phases of sleep and its functions.

Mavanji, et al., Sleep and obesity: A focus on animal models. *Neuroscience and Biobehavioral Reviews*, 2012, 36, 1015-39,

Chapter 12: Ingestive Behavior (Eating; What Starts-Stops a Meal: Brain Mechanisms; Obesity/Anorexia)
Chapter 9: Sleep and Biological Rhythms

7/2 Hormones and Behavior
Aggressive Behavior (offensive and defensive aggression)
The Stress Hormones
Learned Helplessness; PTSD
Learning and Memory - snails to neurogenesis; stress and neurogenesis; Alzheimer's disease

Learning Objectives: The endocrine system is discussed with reference to offensive and defensive aggression and then the stress response and stress hormones. The hormonal and neurochemical regulation of offensive aggression as a mechanism for species dispersal (but not for killing opponents) is compared to defensive aggression (designed to kill opponents). For each form of aggression, the "target of attack" is reviewed and compared. Finally, as above, the neuropathology of human aggression is reviewed. The value of the stress response is first reviewed, particularly with respect to the "healing" qualities of histamine and the glucocorticoids. Then the deleterious effects of chronic stress are reviewed in the context of the biochemical basis of "learned" helplessness.

Exam 2

Chapter 11: Emotion
Chapter 13: Learning and Memory
**Assessment:** Two take home exams, each worth 100 points, will be administered. Each will have two or three essay questions covering the readings and lecture notes. The questions will require students to present a critical assessment of the lecture and reading material. These two exams will each account for 33% of the final grade.

The remaining 34% of the final grade will be a term paper (about 10 pages). The specific topics for each student must be approved by the instructor. In general, the topic should focus on a behavior of interest to the student and account for the behavior from: an evolutionary perspective; a developmental perspective, and/or a neurochemical/neurophysiological perspective. The paper must critically evaluate the current literature on that behavior, identifying strengths and weaknesses of study design. Each paper should conclude with a summary of current knowledge and understanding of the biological basis of the selected behavior.